

## ACUTE ASTHMA, PROGNOSIS, AND TREATMENT

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### Abstract

**Background:** Asthma is a major health problem affecting all ages that increase the mortality rate worldwide. Early detection of its signs and symptoms are essential to control and maintain the disease and effective treatments are administered, such as;  $\beta$ -agonists and corticosteroids. The current review is about acute asthma, prognosis, and treatment.

**Methods:** Scientific articles that linked to the present topic were obtained using an online searching process. The searching process included different scientific websites such as Google Scholar and PubMed. We obtained 16 articles that matched with the current subject and written in English. Of those 16 articles, 4 were excluded as they published before 2000, or may not focusing on the present topic, or written in a language other than English; therefore, only 12 papers were included, and they were published till 2020.

**Results:** Articles were selected according to the inclusion criteria that we selected, and then the discussion of the subject was performed under the main titles.

**Conclusion:** Asthma is one of the most chronic inflammatory disease that increased the mortality rate worldwide. Asthma could affect 300 million individuals and account for one death among 250 death cases. All patients admitted with asthma exacerbation should be assessed promptly through detecting and recognition worsening signs and symptoms. The initial treatment includes oxygen administration, Short-acting  $\beta$ -agonist, and systematic corticosteroids. Decreasing the severity of asthma exacerbations by improving daily therapy for asthma, controlling environmental triggers, and increasing patient education toward asthma risks and how they recognize its symptoms and seek for health care help.

**Keywords:** Asthma exacerbations,  $\beta$ -agonist, corticosteroids, differential diagnosis, fatal and non-fatal asthma.

### Introduction

Asthma is considered as one the most chronic diseases among adults worldwide, also, it could be defined as a chronic air way disease that is accompanied by severe respiratory disease, which known as exacerbations [1, 2]. In another words, asthma exacerbation is associated with increasing of cough, dyspnea, chest tightness, and wheezing that is associated with lung dysfunction [3]. Asthma could affect almost 300 million individuals worldwide, it causes 1.8% million hospitalizations every year [1, 3]. In the United States, asthma affects from 7% to 8% of the adult population that might reached to 24 million and increase the mortality rate that estimated 13.3 deaths/million every year [4, 5]. Elderly population are more likely to experience asthma, especially those who are living in the developing countries [6]. Approximately people with asthma exacerbation from 6% to 13% admitted to the hospital [7], which account almost two million visits to the emergency

department every year [8]. The rate of admission increased by increasing ages, elderly people accounted 14% admission rate more than the younger individuals (7%) [9]. Additionally, the mortality rate increased among elderly people which accounting two-third of deaths cases due to asthma [10]. Therefore, asthma is a fatal disease and should be effectively treated [11].

Asthma exacerbation is treatable and avoidable disease depending on adequate therapy and patient education [12]. The treatment included exacerbation' prompt recognition, severity detection, determination and selecting a proper therapy, providing of acute care if needed [13, 14]. Additionally, the physicians have a vital role in preventing severe asthma exacerbations through identifying patients with high risks for fatal asthma, educate them to could identify/recognize the disease' deterioration. Also, providing an effective plan for patients helping them managing asthma exacerbations and educate them seeking a

help, managing some of comorbidities, such as; sinusitis, chronic obstructive pulmonary disease, rhinitis, atopic dermatitis, obesity, obstructive sleep apnea, and vocal cord dysfunction [15, 16]. Therefore, the current review is about the prognosis and the treatment of acute asthma.

### Materials and Methods

Scientific article that linked to the present topic were obtained by using an online searching process. The searching process included different scientific websites such as Google Scholar and PubMed, using several keywords such as; Asthma exacerbations,  $\beta$ -agonist, corticosteroids, differential diagnosis, fatal and non-fatal asthma. We obtained 16 articles that matched with the current subject and written in English. Of those 16 articles, 4 were excluded as they published before 2000, or mayn't focusing on the present topic, or written in a language other than English; therefore, only 12 papers were included, and they were published till 2020.

### Discussion

#### History and Physical examination

An interview and physical examination are essential to determine the disease severity. Asthma triad includes wheeze, chronic cough, and dyspnea, patients might be diagnosed with all these symptoms or might exhibit only one symptom. Approximately 24% to 35% of population presented with these symptoms are diagnosed with asthma. Persons with audible wheezing are diagnosed with moderate asthma, but absence of wheezing might be a sign of severe airflow obstruction. Asthma symptoms become worse in the early morning or at night [12, 17-18].

Severe asthma symptoms include sensation of air hunger, severe fatigue, cough with/without sputum, insomnia, chest tightness, and inability to lie flat. Additionally, severe asthma had several signs, such as; tachycardia, obtundation, using of accessory muscles of respiration, diaphoresis, chest' hyperinflation, apprehensive appearance, tachypnea, inability to complete sentences, wheezing, and difficulty in lying down. Other signs required hospital admission for emergency care called ominous, such as; signs related with mental status either with or without cyanosis. In additions, signs and symptoms related to pneumomediastinum, pneumonia, and pneumothorax should be examined/investigated by subcutaneous crepitations' palpation, especially in the supraclavicular areas of the chest wall [19, 20].

There are several variables worsen the symptoms of asthma, such as; air pollutants, and sulfites, exposure to triggers, animal dander, pollen, and house dust mites [18]. Additionally, tobacco smoke could worsen lung function, increased exacerbations acuity, and increase the need for healthcare needs [21]. Exposure to chemicals, dusts, non-steroidal anti-inflammatory drugs (NSAIDs), menstrual cycles, and strong emotional expression might worse asthma symptoms [12]. Among children and infants, viral

respiratory infections could lead to asthma exacerbation [22]. Patients' respiratory and pulse rate, and blood pressure should be considered during physical examination and therapy [12]. Severe asthma risk factors should be assessed, such as; numbers of hospital admission and emergency department' visits in the last months and years, intubations, low socio-economic status, illicit drug use, inner-city residence, and other psychosocial problems [23]. Additionally, asthma could be aggravated due to comorbidities, such as; gastroesophageal reflux disease, depression, allergic bronchopulmonary aspergillosis, rhinosinusitis, obstructive sleep apnea, and obesity [23]. Elderly populations suffer from typical asthma symptoms that might reduce bronchoconstriction' perception, which might result in delay of healthcare seeking and increased the risks of severe asthma. Also, elderly patients use some medication which lead to asthma exacerbations, such as; NSAIDs, acetylsalicylic, and  $\beta$ -blockers [24, 25].

#### Differential Diagnosis

Asthma diagnosis could be occurred and confirmed through some quantitative measurements of lung function and using a diagnostic test, such as; spirometry which considered as the most preferred test for diagnosis and could be proceed in the primary care office or in the laboratories of pulmonary function. This test could measure the maximum air volume exhaled from maximum expiration, which known as the forced vital capacity (FVC) and measure the air volume exhaled during the 1<sup>st</sup> second (FEV1). Additionally, spirometry could evaluate symptoms' potential reversibility and obstruction among patients aged above five years old. Fractional exhaled nitric oxide and sputum eosinophils (inflammation biomarkers) could be assessed as a supplementary asthma diagnosis [13, 26-27].

Other differential diagnosis of asthma might include elderly populations with obstructive disease who might have the same features of asthma and chronic obstructive pulmonary disease (COPD), which accounting for 50% and more. Both COPD and asthma' overlap syndrome is distinguished by increased airflow' variability and incompletely reversible airway obstruction [18]. Besides, vocal cord dysfunction, epiglottitis, intrathoracic tracheal obstruction, bronchitis, edema, cardiogenic pulmonary edema, hyperventilation syndrome, bronchiectasis, foreign body, noncardiogenic pulmonary, chemical pneumonitis, pulmonary embolus, and pneumonia are included in the differential diagnosis of asthma [15-19]. In case of acute asthma, diagnosis with chest radiographs aren't necessary if the chest examination didn't reveal any abnormal clinical other than the associated signs and symptoms with an acute exacerbation. While the chest radiograph is urgent in case of complications, such; congestive heart failure, pneumothorax, atelectasis secondary to mucous plugging, or pneumomediastinum [12].

### Predictors of fatal and non-fatal asthma

Fatal or non-fatal asthma' associated risk factors are identified which accelerate early asthma exacerbation' treatment and recognition. This could be occurred if the patients have a history of allergic asthma, has experienced multiple visits to the emergency departments or more hospital admission for seeking intensive care. Also, if the patient has a previous history of episode of near-fatal asthma. Additionally, a previous history of intubation, respiratory failure, and mechanical ventilation. Other suspected allergic symptoms should be assessed, such as; allergy to dust mite species and *Alternaria* species, which is considered as severe asthma' trigger [28].

Poor/improper adherence to medical treatment or prescribed therapy is considered as risk factor. Improper therapy means failure to use inhaled corticosteroids, concomitant use of  $\beta$ -blockers, or excessive use of  $\beta$ -agonists as a primary therapy. It was reported that majority of patients are at a high risk for severe asthma exacerbation due to the highest withdrawal of oral corticosteroids (OCSs). Other risk factors included, lack of education regarding proper management methods, lack of writing a plan for asthma action, and few patients access for adequate health care. Severe asthma exacerbations are associated with socio-economic factors, such as; elderly patients who are residents in the inner-city environments or adolescents' patients didn't adhere to proper therapy. Higher incidence of severe asthma is reported among ethnic groups, such as; Americans of Spanish or African inheritance. Other risk factors included cardiovascular and chronic lungs diseases are also considered risk factors [29].

### Treatment

Asthma exacerbation should be treated and recognized early to achieve the management' success. Patients who are admitted to the emergency department with acute asthma should be quickly assessed for airway adequacy, circulation, and breathing. The assessment could be occurred through a set of pulse oximetry, respiratory effort and rate, and started the treatment promptly [18]. Treatment process didn't depend on evaluation of lung function parameters only, but it based on previous treatment' efficacy and clinical findings [12]. The therapy includes hypoxemia correction, inflammation treatment, and a fast reversal of airway obstruction. The treatment process starts firstly by giving oxygen to maintain the oxygen saturation above 90% [13]. Pollen-sensitive patients with seasonal asthma exacerbation could be treated easily compared to those patients with exacerbation triggered by a viral infection [12].  $\beta$ -agonists are prescribed and given to treat airflow obstruction rapidly, while in case the patients didn't respond to  $\beta$ -agonists or patients exhibited moderate or severe asthma exacerbations, anticholinergics/ systemic corticosteroids are given early for treatment [13]. Inhaled  $\beta$ -agonists and inhaled corticosteroids (ICSs) are effective in treating allergic asthma, while systematic corticosteroids (SCS) are needed to treat the infected patients [30].

### $\beta$ -agonists

$\beta$ -Agonists are bronchodilators that effectively relax bronchial smooth muscle through acting on  $\beta$  receptors. The first line therapy for treating the acute asthma exacerbation use short-acting  $\beta$ -agonists, for example; albuterol which is the common  $\beta$ -agonists used for treating acute asthma [18].

$\beta$ -agonists could be administrated in different forms, such as; nebulizer, intravenous injection, metered-dose inhaler (MDI), and subcutaneous injection. Aerosolized bronchodilators could be administrated by continuous-flow nebulization, while its efficacy increased through administration by MDI. This might be attributed to that MDI is more cost/time effective, compared to nebulizer therapy when administrated with appropriate inhaler technique using spacer device or holding chamber [31]. Additionally, the length of stay at the emergency department significantly decreased by using MDI/spacers, lower cumulative dose of albuterol, higher improvements in peak expiratory flow (PEF), and MDI could be easily administrated at patients' home [32].  $\beta$ -agonists should be used only for treating acute asthma, but if it used on chronic cases might cause tolerance and desensitization. Palpitations, tremor, hypokalemia, hyperglycemia, and tachycardia are the most adverse effects associated with  $\beta$ -agonists [18]. Long-acting  $\beta$ -agonists (LABAs) didn't have any role in treating acute asthma management. While, for long term treatment of moderate to severe asthma, it can be used combined with inhaled corticosteroids [13].

### Corticosteroids

Corticosteroids are considered the most effective anti-inflammatory agents for treating asthma, its action begin and take up to six hours till become clinically apparent [33]. In the emergency department, systemic corticosteroids are used for treating moderate or severe asthma. A short course of corticosteroids and short-acting  $\beta$ -agonists used for asthma exacerbations effectively reduced the rate of relapse [34]. In the acute setting, intramuscular or intravenous corticosteroids could be used in the first acute asthma treatment [29]. While in the ambulatory setting, patients with mild asthma and patients who refused the oral corticosteroids (OCSs) should reserve high dose of ICSs [12]. It is necessary to start the treatment at home before the patient become too ill to could control and manage the disease. ICSs could decrease the most associated risks of systematic corticosteroids (SCSs), such as; psychosis, increased appetite, insomnia, hyperactivity, as well as it impacts on the organ system and bone metabolism. Additionally, ICSs are more effective for patients who overusing  $\beta$ -agonists or patients with upper respiratory tract infections [35]. Additionally, after discharge from hospital, OCSs are administrated to patients with acute asthma, almost 10% to 20% of patients with acute asthma due to unresolved treatment will relapse within two weeks. ICSs therapy could reduce the relapse' changes and ICSs could be used in combination with long acting  $\beta$ -agonists to reduce the dose of ICSs [36].

## Conclusion

Asthma is one of the most chronic inflammatory disease that increased the mortality rate worldwide. Asthma could affect 300 million individuals and account for one death among 250 death cases. All patients admitted with asthma exacerbation should be assessed promptly through detecting and recognition worsening signs and symptoms. The initial treatment includes oxygen administration, Short-acting  $\beta$ -agonist, and systematic corticosteroids. High dose of inhaled corticosteroids is administrated if the patients couldn't tolerate systematic corticosteroids. Decreasing the severity of asthma exacerbations by improving daily therapy for asthma, controlling environmental triggers, and increasing patient education toward asthma risks and how they recognize its symptoms and seek for health care help.

## References

- Masoli M, Fabian D, Holt S, et al. The global burden of asthma: executive summary of the GINA Dissemination Committee Report. *Allergy* 2004;59:469–78.
- Zaidan, M. F., Ameredes, B. T., & Calhoun, W. J. (2020). *Management of Acute Asthma in Adults in 2020*. *JAMA*, 323(6), 563. doi:10.1001/jama.2019.19987.
- Global strategy for asthma management and prevention, 2019. Global Initiative for Asthma website. <https://ginasthma.org/gina-reports>. Accessed January 9, 2019.
- McCracken JL, Veeranki SP, Ameredes BT, Calhoun WJ. Diagnosis and management of asthma in adults: a review. *JAMA*. 2017;318(3):279-290.
- Public Health Agency of Canada. Life and breath: respiratory disease in Canada. 2007. Available at: <http://www.phac-aspc.gc.ca/publicat/2007/lbrdc-vsmrc/indexeng.php#tphp>. Accessed October 27, 2011.
- Lai CKW, Beasley R, Crane J, et al. Global variation in the prevalence and severity of asthma symptoms: Phase Three of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* 2009;64:476–83.
- Lougheed MD, Garvey N, Chapman KR. The Ontario Asthma Regional Variation Study: emergency department visit rates and the relation to hospitalization rates. *Chest* 2006;129:909–17.
- Moorman JE, Rudd RA, Johnson CA. National surveillance for asthma—United States, 1980–2004. *MMWR Surveill Summ* 2007;56:1–54.
- Diette G, Krishnan JA, Dominici F, et al. Asthma in older adults: factors associated with hospitalization. *Arch Intern Med* 2002;162(10):1123–32.
- Gibson P, McDonald V, Marks G. Asthma in older adults. *Lancet* 2010;376(9743):803–13.
- Chen Y, Johansen H, Thillaiampalam S, et al. “Asthma”. *Health Reports*. Statistics Canada Catalogue 2005;no. 82-003.16(2):43–6.
- Ferguson JE, Patel SS, Lockey RF. Acute asthma, prognosis, and treatment. *J Allergy Clin Immunol*. 2017 Feb;139(2):438-447. doi: 10.1016/j.jaci.2016.06.054. Epub 2016 Aug 20. PMID: 27554811.
- Gibson PG, Yang IA, Upham JW, et al. Effect of azithromycin on asthma exacerbations and quality of life in adults with persistent uncontrolled asthma (AMAZES): a randomised, double-blind, placebo-controlled trial. *Lancet*. 2017;390(10095): 659-668. doi:10.1016/S0140-6736(17)31281-3
- Kew KM, Kirtchuk L, Mitchell CI. Intravenous magnesium sulfate for treating adults with acute asthma in the emergency department. *Cochrane Database Syst Rev*. 2014;(5):CD010909.
- Lockey RF, Ledford DK, in collaboration with the World Allergy Organization, editors. *Asthma, comorbidities, co-existing conditions, and differential diagnoses*. New York: Oxford University Press; 2014. pp. 231-367.
- Blake K, Teague WG. Gastroesophageal reflux disease and childhood asthma. *Curr Opin Pulm Med* 2013;19:24-9.
- Irwin R, Curley FJ, French CL. Chronic cough. The spectrum and frequency of causes, key components of the diagnostic evaluation, and outcome of specific therapy. *Am Rev Respir Dis* 1990;141:640–7.
- Murata A, Ling PM. Asthma diagnosis and management. *Emerg Med Clin North Am*. 2012 May;30(2):203-22, vii. doi: 10.1016/j.emc.2011.10.004. Epub 2011 Dec 7. PMID: 22487105.
- Schatz M, Rosenwasser L. The allergic asthma phenotype. *J Allergy Clin Immunol Pract* 2014;2:645-9.
- Global Initiative for Asthma (GINA) Website. Available at: <http://www.ginasthma.com/>. Accessed March 15, 2015.
- Comhair SA, Gaston BM, Ricci KS, et al, National Heart Lung Blood Institute Severe Asthma Research Program (SARP). Detrimental effects of environmental tobacco smoke in relation to asthma severity. *PLoS One* 2011;6(5):e18574.
- Martinez FD, Wright AL, Taussig LM, et al. Asthma and wheezing in the first six years of life. *N Engl J Med* 1995;332(3):133–8.
- National Asthma Education and Prevention Program. Expert panel report III: guidelines for the diagnosis and management of asthma. Bethesda (MD): National Heart, Lung, and Blood Institute; 2007 (NIH publication no. 08-4051).
- Ekici M, Apan A, Ekici A, et al. Perception of bronchoconstriction in elderly asthmatics. *J Asthma* 2001;38(8):691–6.
- Brooks TW, Creekmore FM, Young DC, et al. Rates of hospitalizations and emergency department visits in patients with asthma and chronic obstructive pulmonary disease taking beta-blockers. *Pharmacotherapy* 2007; 27(5):684–90.

26. Deykin A, Lazarus SC, Fahy JV, et al, Asthma Clinic Research Network, National Heart, Lung and Blood Institute/NIH. Sputum eosinophil counts predict asthma control after discontinuation of inhaled corticosteroids. *J Allergy Clin Immunol* 2005;115(4):720–7.
27. Smith AD, Cowan JO, Brassett KP, et al. Use of exhaled nitric oxide measurements to guide treatment in chronic asthma. *N Engl J Med* 2005;352(21): 2163–73.
28. Nelson R, DiNicolo R, Fernandez-Caldas E, Seleznik MJ, Lockey RF, Good R. Allergen-specific IgE levels and mite allergen exposure in children with acute asthma first seen in an emergency department and in nonasthmatic control subjects. *J Allergy Clin Immunol* 1996;98:258-63.
29. Camargo CA, Rachelefsky G, Schatz M. Managing asthma exacerbations in the emergency department: summary of the National Asthma Education and Prevention Program Expert Panel Report 3 guidelines for the management of asthma exacerbations. *Proc Am Thorac Soc* 2009;6:357-66.
30. Goodacre S, Bradburn M, Cohen J, Gray A, Bengner J, Coats T, et al. Prediction of unsuccessful treatment in patients with severe asthma. *EmergMed J* 2014;31:e40-5.
31. Newman KB, Milne S, Hamilton C, et al. A comparison of albuterol administered by metered-dose inhaler and spacer with albuterol by nebulizer in adults presenting to an urban emergency department with acute asthma. *Chest* 2002; 121(4):1036–41.
32. Burrows T, Connett GJ. The relative benefits and acceptability of metered dose inhalers and nebulisers to treat acute asthma in preschool children [abstract]. *Thorax* 2004;59(Suppl 2):ii20.
33. Hood PP, Cotter TP, Costello JE, et al. Effect of intravenous corticosteroid on ex vivo leukotriene generation by blood leucocytes of normal and asthmatic patients. *Thorax* 1999;54(12):1075–82.
34. Rowe BH, Spooner CH, Ducharme FM, et al. Corticosteroids for preventing relapse following acute exacerbations of asthma. *Cochrane Database Syst Rev* 2007;3:CD000195.
35. Krishnan J, Nowak R, Davis S, Schatz M. Anti-inflammatory treatment after discharge home from the emergency department in adults with acute asthma. *J Allergy Clin Immunol* 2009;124(suppl):S29-34.
36. Kang MG, Kim JY, Jung JW, Song JW, Cho SH, Min KU, et al. Lost to follow up in asthmatics does not mean treatment failure: causes and clinical outcomes of non-adherence to outpatient treatment in adult asthma. *Allergy Asthma Immunol Res* 2013;5:357-64.